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TUNG & ASSOCIATES
Suite 120
838 W. Long Lake Road
Bloomfield Hills, MI 48302

EXAMINER

ALANKO, ANITA KAREN

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 03/23/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/077,720	Applicant(s) SU ET AL.	
	Examiner Anita K Alanko	Art Unit 1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 January 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-5,8-10,13 and 17-27 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-5,8-10,13 and 17-27 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
 If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
 a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____ |

Specification

The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: the specification does not describe etching a low-k carbon containing dielectric material layer. The only mention of carbon containing materials is in the background of the invention. Since carbon was cited in the originally filed claims, there is basis for terminology in the claims, but the description of carbon is missing from the specification. The specification is also objected to because of a minor informality; on page 18, line 5 of paragraph [0036], the specification recites “hydrofluorocarbons such as C₄F₈, C₅F₈, or C₄F₆” are present, however none of these compositions contain hydrogen.

Claim Rejections - 35 USC § 112

Claims 1, 3-5, 8-10, 13 and 17-27 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 is indefinite because it cannot simultaneously cite that oxygen is not present (by using the phrase “consisting essentially of”), and then also cite that oxygen is present (the step of optionally adding oxygen). The phrase “consisting essentially of” restricts the plasma to components that do not materially affect the process, however adding oxygen does materially affect the process since it controls the critical dimension bias. Applicant may split this claim into two different independent claims- one with oxygen and one without oxygen.

Claims 1, 10 and 23 are also unclear because it cites "carrying out a first plasma etching process consisting essentially of hydrogen..." The claims would be more clear if they cited - - carrying out a first plasma etching process *by introducing a gas* consisting essentially of hydrogen... *into the etch chamber*- - in order to make the sentence more complete.

Further, the term "improved" in claims 1, 10 and 23, line 2 is a relative term that renders the metes and bounds of the claim unclear. It may be simply deleted. Line 9 of claim 1 cites "least one" twice.

Claim 8 does not further limit its base claim because the base claim does not require that oxygen is present.

Claim 22 is indefinite because it cites that the members of the Markush group contain hydrogen, however none of the members listed contain hydrogen. The term "hydrogen" may be simply deleted.

Claims 3-5, 9, 13, 17-22, 24-27 do not cure the indefiniteness of their base claim, and are therefore also rejected.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 3-5, 8 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu (US 6,346,474 B1) in view of Li et al (JVSTB 1995).

Liu discloses a method comprising:

providing a substrate 10 comprising a low dielectric constant material 12 (col.2, lines 45-65) including at least one overlayer of a nitride 14 (silicon nitride; col.3, line 8) containing material on top;

forming a photoresist layer 16 overlying the at least one overlayer of said nitride containing material;

patterning said photoresist layer photolithographically for an etching process (as is obvious to pattern a photoresist layer, Fig.1);

providing an ambient in said etch chamber conducive to forming a plasma including a hydrofluorocarbon (CHF_3 , col.3, lines 42-44);

forming a plasma; and

whereby the at least one overlayer of said nitride containing material is preferentially etched through to a thickness to form an opening (col.3, lines 42-45).

Liu discloses to add CO to the plasma, which contributes oxygen species to the plasma, but does not disclose to add nitrogen gas.

Li discloses a method for plasma etching with improved etching selectivity for a nitride containing material with respect to a photoresist layer (see abstract, first sentence). Li teaches that a useful etchant for etching silicon nitride through a photoresist mask consists essentially of a hydrogen containing fluorocarbon (CHF_3) and nitrogen (see pages 2008-2009, the section entitled "II. Experiments").

It would have been obvious to one with ordinary skill in the art to etch the silicon nitride layer in the method of Liu using the etchant composition of Li because Li teaches that it is a useful etchant for patterning silicon nitride through a photoresist mask.

As to claims 3-4, Liu discloses that the nitride containing material comprises silicon nitride, a DARC.

As to claim 5, since the modified method of Liu has the same method steps as the instant invention, the same result of sidewall formation is expected.

As to claim 8, Li discloses a nitrogen flow rate of up to 50 sccm, the last data point in Figure 1 appears to be at about 48 sccm, which is about 50 sccm as cited in the claim; the hydrofluorocarbon flow rate also encompasses flow rates of 20-50 sccm (Figure 1), which falls within the range cited. Oxygen is an optional addition, and is not added.

Claims 1, 3-5, 8-9 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu (US 6,346,474 B1) in view of Li et al (JVSTB 1995) and Oehrlein et al (US 6,060,400).

The discussion of modified Liu from above is repeated here.

As to claim 9, Liu does not disclose to use microwave power to form the plasma. Oehrlein teaches a silicon nitride etch process that includes a forming a plasma with microwave power 206 of 1000 W (col.7, line 19) and using a composition comprising fluorocarbon, nitrogen and oxygen (Fig.3). It would have been obvious to one with ordinary skill in the art to etch with a microwave power in the modified method of Liu because Oehrlein teaches that this is a useful means to form a plasma for silicon nitride, and is a functionally equivalent means of forming reactive species for etching silicon nitride.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 10, 13, 17-20, 22-27 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-36 of U.S. Patent No. 6,495, 469 B1 in view of Wang et al (US 6,383,919 B1). US Patent 6,495,469 does not disclose to use an etch stop underlayer. Wang teaches that etch stop underlayers such as silicon nitride are useful in the structure of 6,495,469 in order to protect conductive material during the etching of overlying dielectric layers (col.6, lines 1-10). It would have been obvious to one with ordinary skill in the art to form an etch stop underlayer in the method of 6,495,469 because Wang teaches etch stop underlayers such as silicon nitride are useful in order to protect conductive material during the etching of overlying dielectric layers.

Claims 10,13,17-20, 22-27 are directed to an invention not patentably distinct from claims 1-36 of commonly assigned 6,495,469. Specifically, see rejection above.

The U.S. Patent and Trademark Office normally will not institute an interference between applications or a patent and an application of common ownership (see MPEP § 2302).

Commonly assigned 6,495,469, discussed above, would form the basis for a rejection of the noted claims under 35 U.S.C. 103(a) if the commonly assigned case qualifies as prior art under 35 U.S.C. 102(f) or (g) and the conflicting inventions were not commonly owned at the time the invention in this application was made. In order for the examiner to resolve this issue, the assignee is required under 35 U.S.C. 103(c) and 37 CFR 1.78(c) to either show that the conflicting inventions were commonly owned at the time the invention in this application was made or to name the prior inventor of the conflicting subject matter. Failure to comply with this requirement will result in a holding of abandonment of the application.

A showing that the inventions were commonly owned at the time the invention in this application was made will preclude a rejection under 35 U.S.C. 103(a) based upon the commonly assigned case as a reference under 35 U.S.C. 102(f) or (g), or 35 U.S.C. 102(e) for applications filed on or after November 29, 1999.

Allowable Subject Matter

Claims 10, 13, 17-20, 22-27 are allowable over the prior art.

The following is a statement of reasons for the indication of allowable subject matter: the prior art does not teach or suggest a method for plasma etching a low-K carbon containing dielectric material layer and underlying etch stop layer comprising the steps of:

providing a substrate comprising a low-K carbon containing dielectric material layer overlying a nitride containing etch stop layer in an etch chamber,

providing a photoresist layer overlying the low-K carbon containing dielectric material layer;

defining a pattern comprising the photoresist layer such that a portion of the low-K carbon containing dielectric material layer is exposed for etching, and

carrying out a first plasma etching process by introducing a gas comprising hydrogen containing fluorocarbons, nitrogen and oxygen into said etch chamber at a nitrogen to oxygen ratio of at least 10 to etch and a fluorine to carbon ratio within a range of 2 to 3 to etch through a thickness portion of the low-K carbon containing dielectric material layer, as in the context of claim 10.

The closest prior art, Li et al (US 6,284,149), teaches a plasma etch process with similar layers and etchants, however the etchant has a much lower nitrogen to oxygen ratio (col.15-16, Tables 4-5) and there is no motivation to change it to that cited, as in the context of claim 10.

Response to Amendment

The 103 rejection over Liu in view of Oehrlein is withdrawn. The claims are now rejected over Liu in view of Li, and over Liu in view of Li and Oehrlein. The claims are also rejected under 35 USC 112, and the specification is objected to.

Response to Arguments

Applicant's arguments filed 1/7/04 have been fully considered. Applicant's arguments about Oehrlein are persuasive in that Oehrlein teaches a different nitrogen to oxygen ratio than in

the instant invention. However, newly cited Li is now relied upon to teach a useful etchant for silicon nitride through a photoresist mask.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anita K Alanko whose telephone number is 571-272-1458. The examiner can normally be reached on Mon, Tues & Fri: 8:30 am-5 pm; Wed&Thurs: 10 am-2 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 1765

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Anita K. Alanko

Anita K Alanko
Primary Examiner
Art Unit 1765